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(54) Abstract Title: **Converting between different versions of a standard at an interface between a network management centre and a network element manager**

(57) A method, and apparatus for, mediating between a telecommunications network management centre (NMC) (10) and a telecommunications network element manager (NEM) (4) over an interface (15) defined by a standard, the NMC (10) using a first version of the standard and the NEM (4) using a second version of the standard. For example, this may be used for different versions of the north bound interface (NBI) of the Universal Mobile Telecommunications System (UMTS) Management standard. A mediator (21) is provided that converts a request received from e.g. an Integration Reference Point (IRP) manager (23) of an NMC (10) under the first version of the standard to a corresponding request under the second version of the standard which it sends to e.g. an IRP agent (27) of an NEM (4); receives back a response under the second version of the standard; converts the response to a corresponding response under the first version of the standard; and sends the converted response under the first version of the standard to the IRP manager (23).

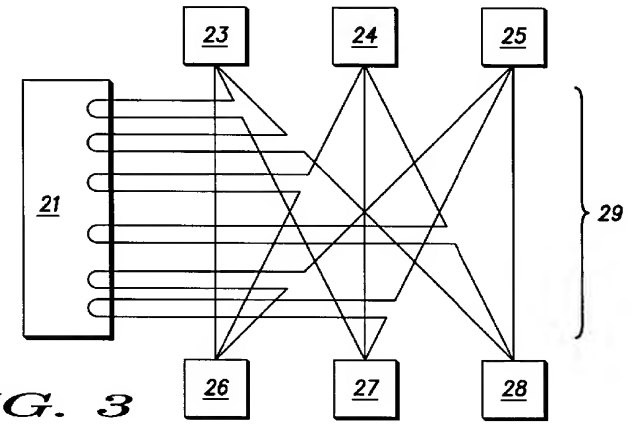

FIG. 3

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.
Original Printed on Recycled Paper

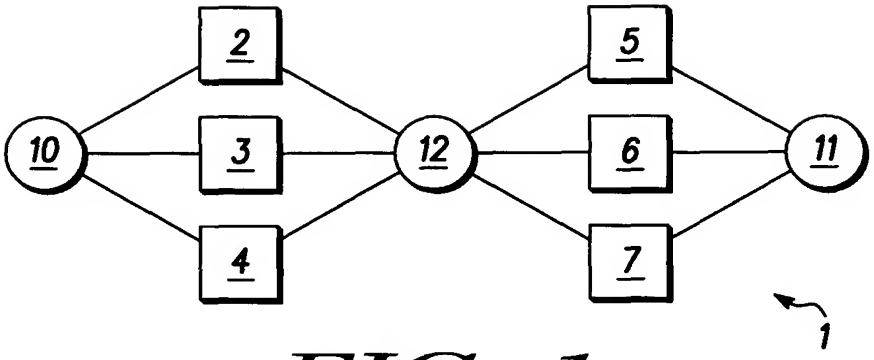

FIG. 1

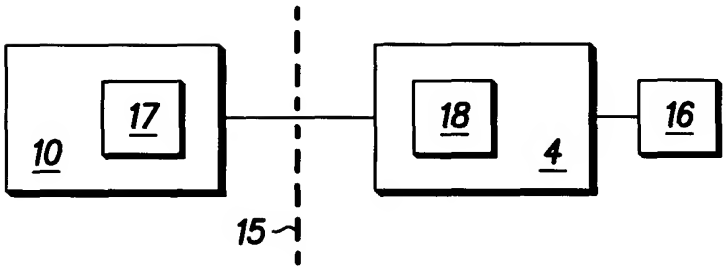

FIG. 2

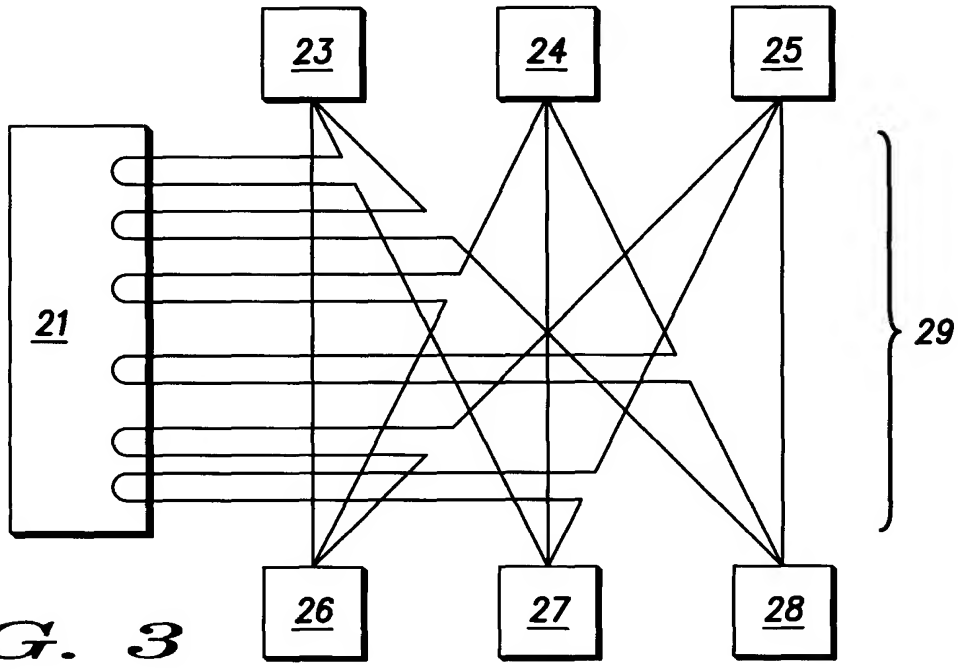

FIG. 3

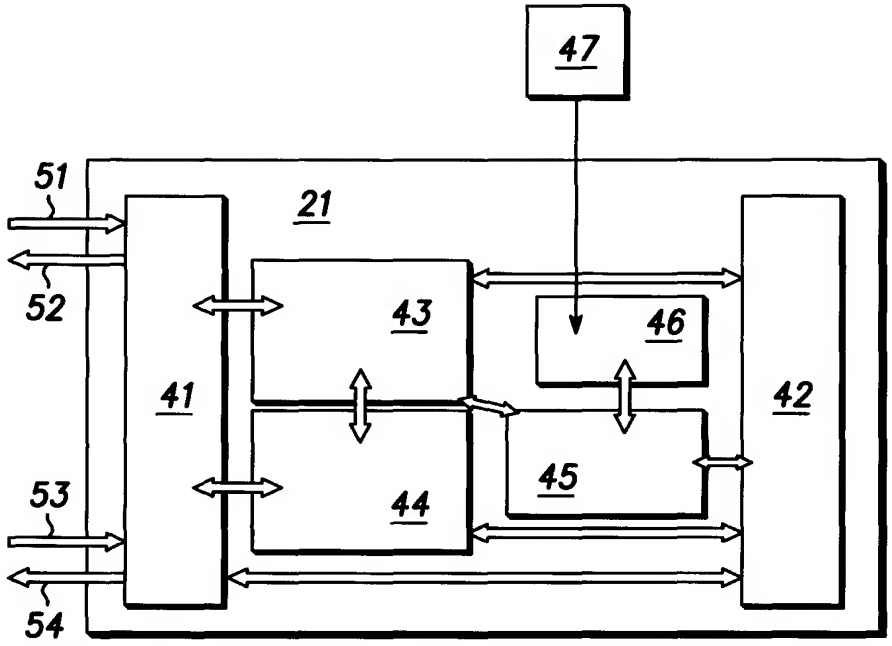

FIG. 4

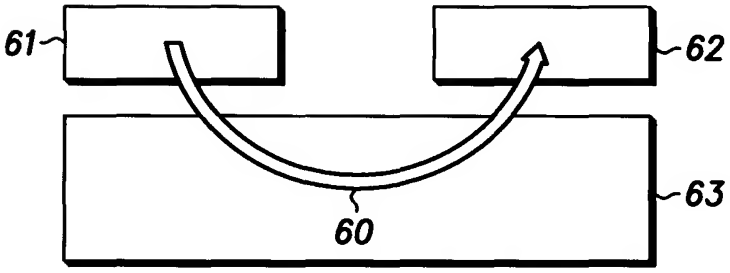

FIG. 5

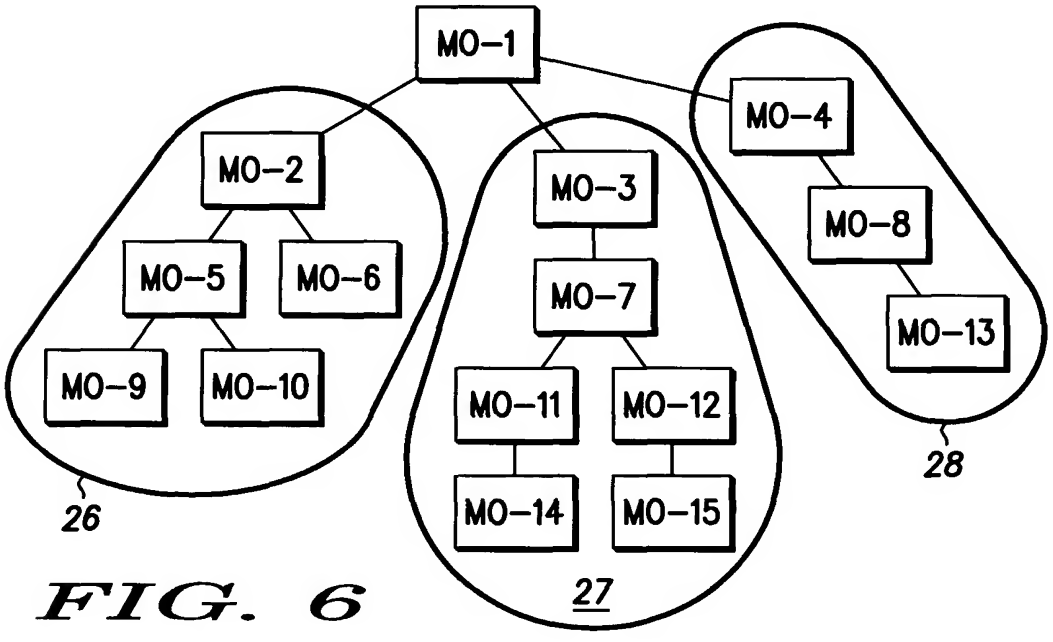

FIG. 6

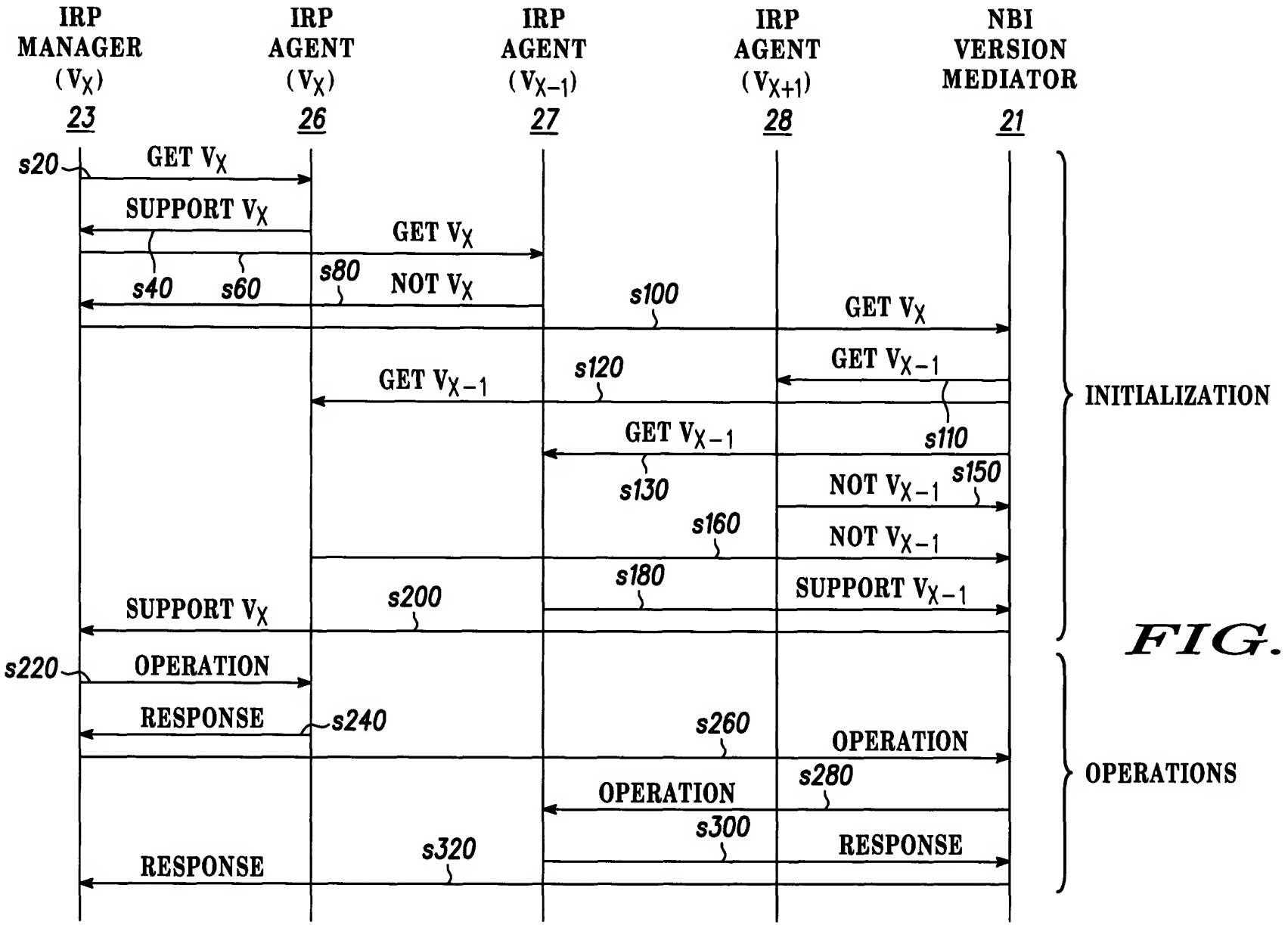
IRP MANAGER (V_X) 23
IRP AGENT (V_X) 26
IRP AGENT (V_{X-1}) 27
IRP AGENT (V_{X+1}) 28
NBI VERSION MEDIATOR 21
s20
GET V_X
SUPPORT V_X
GET V_X
s40
s60
s80
NOT V_X
s100
GET V_X
GET V_{X-1}
s120
GET V_{X-1}
s110
GET V_{X-1}
s130
NOT V_{X-1}
s150
s160
NOT V_{X-1}
s180
SUPPORT V_{X-1}
s200
SUPPORT V_X
INITIALIZATION
s220
OPERATION
RESPONSE
s240
s260
OPERATION
s280
OPERATION
s300
RESPONSE
s320
RESPONSE
OPERATIONS

FIG. 7

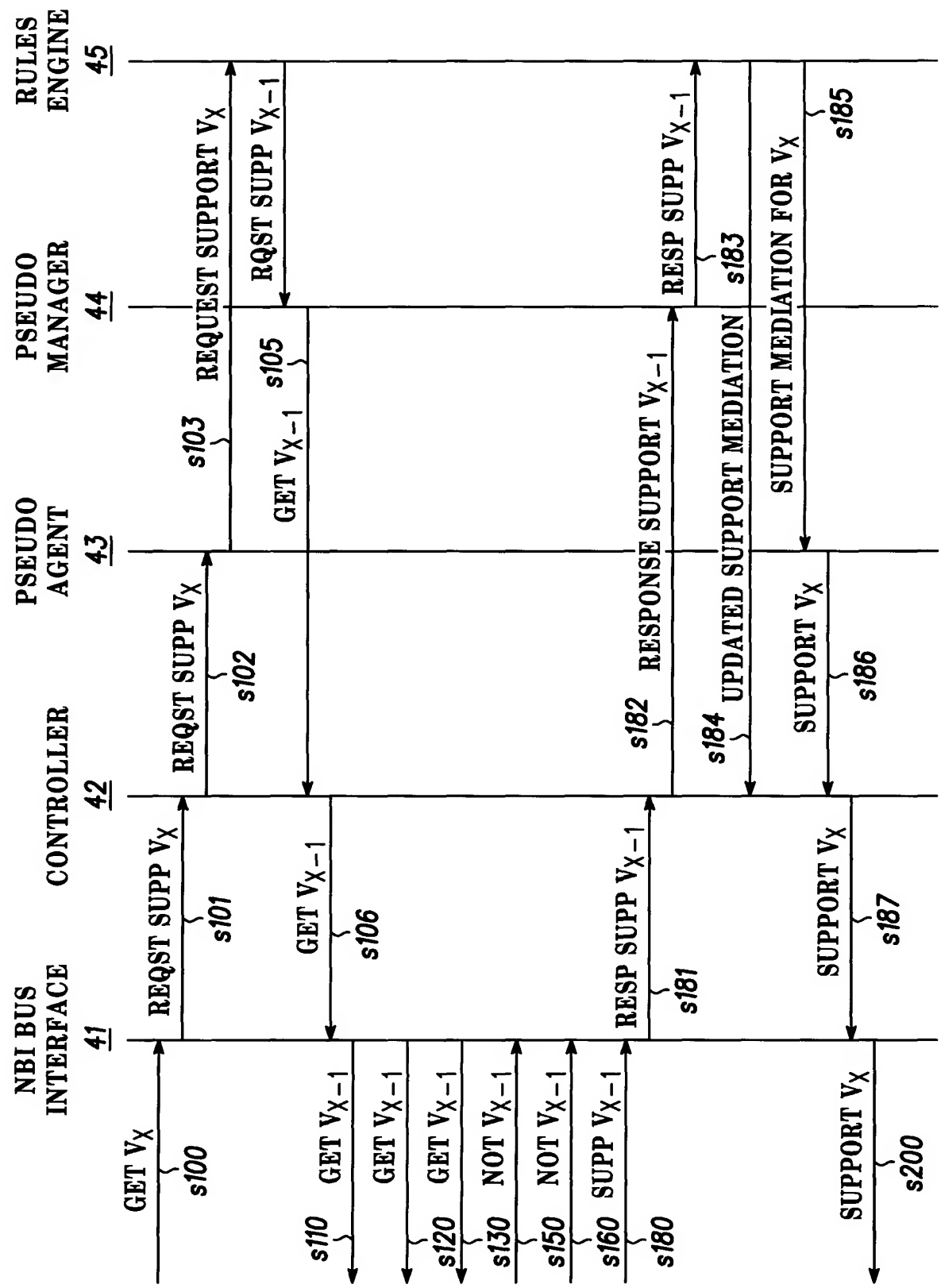
NBI BUS INTERFACE 41
CONTROLLER 42
PSEUDO AGENT 43
PSEUDO MANAGER 44
RULES ENGINE 45
GET V_X s100
REQST SUPP V_X s101
REQST SUPP V_X s102
REQUEST SUPPORT V_X s103
RQST SUPP V_{X-1}
GET V_{X-1} s105
GET V_{X-1} s106
GET V_{X-1} s110
GET V_{X-1} s120
NOT V_{X-1} s130
NOT V_{X-1} s150
SUPP V_{X-1} s160
RESP SUPP V_{X-1} s180
RESP SUPP V_{X-1} s181
RESPONSE SUPPORT V_{X-1} s182
RESP SUPP V_{X-1} s183
UPDATED SUPPORT MEDIATION s184
SUPPORT MEDIATION FOR V_X s185
SUPPORT V_X s186
SUPPORT V_X s187
SUPPORT V_X s200

FIG. 8

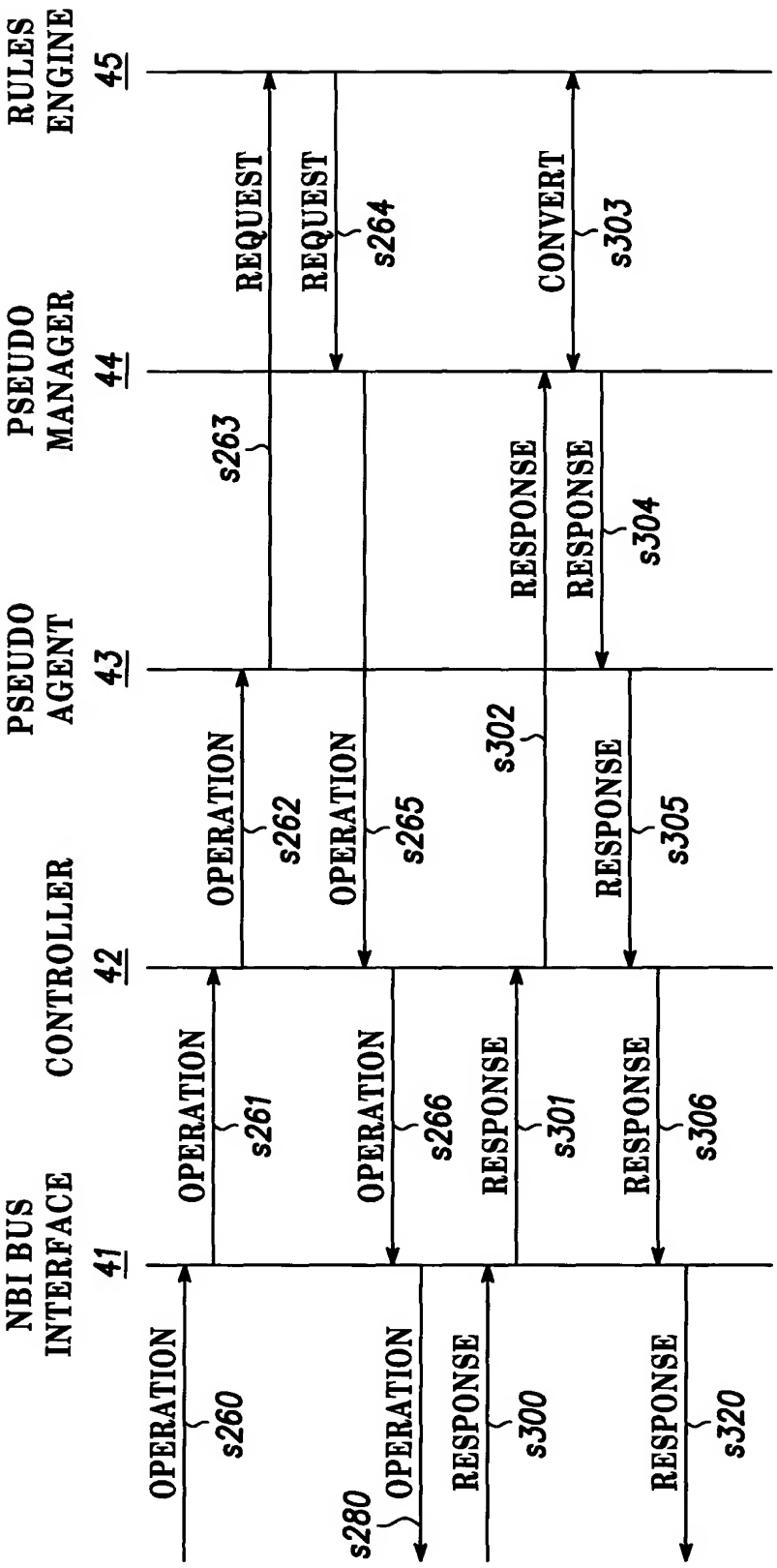
NBI BUS INTERFACE
41
CONTROLLER
42
PSEUDO AGENT
43
PSEUDO MANAGER
44
RULES ENGINE
45
OPERATION
s260
OPERATION
s261
OPERATION
s262
REQUEST
s263
REQUEST
s264
OPERATION
s265
OPERATION
s266
s280
RESPONSE
s300
RESPONSE
s301
s302
RESPONSE
s303
RESPONSE
s304
RESPONSE
s305
RESPONSE
s306
RESPONSE
s320
CONVERT

FIG. 9

TELECOMMUNICATIONS NETWORK MANAGEMENT

Field of the Invention

The present invention relates to managing elements in a communications system. The present invention relates in particular, but not exclusively, to operations, administration, maintenance and provisioning in a national telecommunications network including cellular communications systems, the cellular communications systems including for example Universal Mobile Telecommunications System (UMTS), General Packet Radio Service (GPRS) and Global System for Mobile Telecommunication (GSM) systems.

Background of the Invention

The component parts of communications systems and networks may be divided into "communication elements" and "management parts". The communication elements includes those parts whose basic function is implementing communication between parties in the system. In the case of cellular communications systems for example, these include base stations and switching centres (Node-B's and Radio Network Controllers (RNCs) respectively in the case of UMTS systems).

The management parts include those parts whose basic function is to manage and support the operation of the communication elements of a network or system. In the case of cellular communications systems, for example, these include Operations and Management Centres (OMCs), also known as

Operations, Administration and Maintenance (OA&M) or Operations, Administration, Maintenance and Provisioning (OAM&P). These contain databanks and instructions for managing operation of communications parts, e.g. a management part for a base station may include instructions for which radio frequencies the base station should transmit and receive on, data relating to handover, and so on.

The management parts may be located in separate locations to the communications parts, or may be co-located therewith, the division comprising a functional division rather than a strict geographical division.

In some communications systems or networks, the management parts are implemented in two or more hierarchical levels. This is the case for those systems which include UMTS and/or GPRS elements. For these, the OAM&P is implemented at two levels defined in the Third Generation Partnership Project (3GPP) Technical Specifications (i.e. 3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; 3G Telecom Management: Principles and high level requirements (Release 5)).

The higher level comprises Network Management Centres (NMCs) and the lower level comprises Network Element Managers (NEMs). The NEMs manage one or more specific elements of the network (i.e. one or more communications elements when put in the terminology used above), whereas the NMCs manage aspects related to an overall system or network, or at any least a

more substantial number of communications elements than are managed by the NEMs.

The NMCs share an interface with the NEMs. This is referred to as the North Bound Interface (NBI), and is also defined in the above mentioned 3GPP Technical Specification. This enables multi-vendor NEMs to be managed by NMCs developed by various Independent Software Vendors (ISVs). Conceptually the NBI standard is modelled and specified by reference to the NBI with an Integration Reference Point (IRP) Manager responsible for implementing the so-called "north" requirements in the NMC (i.e. transmission from the NMC to the NEM, which direction is termed north in this interface) and an IRP Agent responsible for implementing the so-called "south" requirements in the NEM (i.e. transmission from the NEM to the NMC, which direction is termed south in this interface).

Due the way the standardization processes for technical standards such as the above mentioned 3GPP Technical Specification proceeds, the scope of the NBI is expanded as updated versions of the 3GPP Technical Specification are agreed and issued. For 3GPP this is done on a release basis, e.g. R99, R4 and R5.

This poses a problem when trying to deploy new versions of the NBI and for vendors and ISVs being able to support forward and backward compatibility. Ideally, to support rollout of release keeping the network operational all IRP Manager and IRP Agents instances would be able to support all valid versions. However, this is not achievable in practice. Vendors and ISVs may only be able

to support a subset of versions, for example a new vendor included in a network may only support the latest version, or an NMC supporting legacy features would not be maintained or required to support newer releases.

If IRP Managers and IRP Agents support different versions there may be incompatibilities at various levels. For example:-

1) Behaviour

2) New/changed Operations

3) New/changed Operations parameters

4) New/changed Managed Object Classes (MOC)

5) New/changed MOC attributes.

Summary of the Invention

In a first aspect, the present invention provides a method of communicating between a telecommunications network management centre and a telecommunications network element manager, as claimed in claim 1.

In a further aspect, the present invention provides a method of mediating communication between a telecommunications network management centre and a telecommunications network element manager, as claimed in claim 2.

In a further aspect, the present invention provides a storage medium storing processor-implementable instructions, as claimed in claim 9.

In a further aspect, the present invention provides apparatus for mediating communication between a telecommunications network management centre and a telecommunications network element manager, as claimed in claim 10.

In further aspects, the present invention provides a system and method for alleviating or resolving NBI (or equivalent interfaces) version incompatibilities between network managers and network element managers by means of mediation.

The present invention tends to alleviate or resolve incompatibilities across two versions of the interface when there are differences and it is required to support forward and backward incompatibilities in the network, e.g. over the NBI. For example, the following issues may be mediated:-

1) Behaviour

2) New/changed Operations

3) New/changed Operations parameters

4) New/changed Managed Object Classes (MOC)

5) New/changed MOC attributes.

The present invention tends to allow network and system operators to simply rollout new NBI versions in live networks, and to support backward and forward compatibility across different vendor's NEM and ISVs NMC applications.

Brief Description of the Drawings

Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

FIG. 1 is a schematic illustration of a communications network;

FIG. 2 is a schematic illustration showing a North Bound Interface (NBI) established between a network management centre and a network element manager;

FIG. 3 is a schematic illustration showing an arrangement in which an NBI Version Mediator is arranged to provide enhanced compatibility between IRP Managers and IRP Agents over an NBI;

FIG. 4 is schematic illustration of the NBI Version Mediator of FIG. 3 in terms of functional modules;

FIG. 5 is a schematic illustration representing a request being sent by a client to an object implementation;

FIG. 6 is a schematic illustration of a managed object containment tree, with IRP Agents scope superimposed over them;

FIG. 7 is a call sequence flowchart showing process steps employed at a network level in an embodiment of the present invention;

FIG. 8 is a call sequence flowchart showing process steps employed internally by the NBI Version Mediator of FIGs. 3 and 4 during an initialisation stage of the process shown in FIG. 7; and

FIG. 9 is a call sequence flowchart showing process steps employed internally by the NBI Version Mediator of FIGs. 3 and 4 during an operation stage of the process shown in FIG. 7.

Description of Preferred Embodiments

FIG. 1 is a schematic illustration of a communications network 1 showing certain management components thereof. The network comprises cellular communications systems including UMTS and GPRS systems. These systems and other parts of the network comprise network elements (i.e. communication elements) such as base stations, switching centres (e.g. Node-B's and RNCs), and Internet Protocol (IP) nodes. For clarity, the network elements are not shown in FIG. 1.

The management components shown in FIG. 1 are arranged to manage the above described network elements. In this embodiment the management components comprise network element managers (NEMs) 2, 3, 4, 5, 6, 7 and network management centres (NMCs) 10, 11, 12 as specified in the 3GPP

Technical Specification. The NEMs and NMCs are interconnected as shown in FIG. 1. The NEMs 2, 3, 4, 5, 6, 7 are also each coupled to one or more respective network elements.

Communication between the NMCs and the NEMs is performed over the above described North Bound Interface (NBI). For example, FIG. 2 is a schematic illustration showing an NBI 15 established between NMC 10 and NEM 4. Also shown in FIG. 2 is a connection between the NEM 4 and a network element (NE) 16 it is arranged to manage. The NMC 10 comprises an application called an Integration Reference Point (IRP) Manager 17. The NEM 4 comprises an application called an IRP Agent 18.

Different release versions of IRP Managers and IRP Agents may be present in a given network as standards and commercial requirements are modified. Also, different instances of IRP Managers and IRP Agents may be present, as different vendors or service providers build their own versions of these items. In this embodiment, an NBI version mediator is provided to give enhanced compatibility between different versions and instances of IRP Managers and IRP agents. (The term "instances" is used to refer to variations or replications of e.g. an Agent or a Manager which are substantially equivalent but may contain certain variations or differences. For example, different instances of an Agent may be generally intended to perform the same role to a same standard, but may be designed and implemented by two different vendors, and hence may show certain variations in how they operate or respond, perhaps in some detailed areas.)

FIG. 3 is a schematic illustration showing an NBI Version Mediator 21 arranged to provide enhanced compatibility between IRP Managers 23, 24, 25 and IRP Agents 26, 27, 28 over an NBI 29. FIG. 3 is a simplified idealised illustration representing an overview of how the NBI Version Mediator may be used to provide compatible interaction between the different versions of IRP Managers and IRP Agents. IRP Manager 23 is, say, a version "x"; IRP Manager 24 is, say, a version "x-1"; and IRP Manager 25 is, say, a version "x+1". Similarly, IRP Agent 26 is, say, a version "x"; IRP Agent 27 is, say, a version "x-1"; and IRP Agent 28 is, say, a version "x+1".

In this example, let us assume that each version of IRP Manager can only communicate adequately with the corresponding version of IRP Agent (and vice-versa) in the absence of the NBI Version Mediator 21. FIG. 3 shows how, in this case, communication is performed directly between each IRP Manager and its corresponding same version IRP Agent (i.e. IRP Manager 23 directly with IRP Agent 26, both version x; IRP Manager 24 directly with IRP Agent 27, both version x-1; and IRP manager 25 directly with IRP Agent 28, both version x+1). FIG. 3 further schematically shows the NBI Version Mediator 21 facilitating communication between each IRP Manager and IRP Agent (and vice-versa) which in combination is of different respective versions (i.e. communication between IRP Manager 23 being version x and each of IRP Agent 27 being version x-1 and IRP Agent 28 being version x+1; communication between IRP Manager 24 being version x-1 and each of IRP Agent 26 being version x and IRP Agent 28 being version x+1; and communication between IRP Manager 25 being version

x+1 and each of IRP Agent 26 being version x and IRP Agent 27 being version x-1).

An overview of the operation of the NBI Version Mediator 21 will now be described. As defined in the 3GPP Technical Specification (e.g. CORBA reference 3GPP 32.xxx series of specifications, where CORBA is Common Object Resource Broker Architecture), the NBI in effect has an NBI bus. The NBI Version Mediator 21 sits on the NBI bus and exposes itself as instances of both pseudo IRP Managers and pseudo IRP Agents capable of supporting all (or at least a useful number of) versions of the NBI, IRPs & NRMs (see 3GPP 32.xxx series of specifications) required to be supported across a network. The NBI Version Mediator exposes itself on the interface when an IRP Manager instance and an IRP Agent instance need to communicate and can only support incompatible versions of NBI. In these cases the NBI Version Mediator 21 intervenes between the IRP Manager and IRP Agent, so that the IRP Agent sees the IRP Manager as its own version and the IRP Manager sees the IRP Agent as its own version. Software in and/or forming part of the NBI Version Mediator 21 is responsible for resolving the incompatibilities across the two version of the interface when there are differences and it is required to support forward and backward incompatibilities in the network over the NBI. For example, the following may be mediated:-

1) Behaviour

2) New/changed Operations

3) New/changed Operations parameters

4) New/changed Managed Object Classes (MOC)

5) New/changed MOC attributes.

In conventional arrangements, The IRP Manager is responsible for discovering which instances of IRP Agent support its requirements for managing the network (Versions for IRPs (operations etc), NRMs (MOCs etc), NE instances). Generally, The IRP Managers first make a broadcast or similar method (e.g. search) to discover all the real IRP Agent instances in a network and identify the details of what NBI they can support. The IRP Manager collate the responses so that subsequently all associated NBI management operations across the NBI can be directed by the IRP Manager to an appropriate IRP Agent instance capable of supporting the scope of the operations (scope includes Versions for IRPs (operations etc), NRMs (MOCs etc), NE instances) the IRP Manager requires to be supported and that it is compatible with.

In this embodiment, in similar fashion to an IRP Manager, the NBI Version Mediator 21 performs a similar broadcast to discover all the real IRP Agents, identify what they can support, and collate the responses.

Preferably, following the first broadcast for discovery, the IRP Manager secondly, if required, explicitly requests the NBI Version Mediator 21 as an Agent if it can support specific scopes that could not be discovered as being supported by the real IRP Agents in the network .

In other words, firstly the IRP Manager requests the "real" IRP Agents, i.e. sends an appropriate request message, enquiring they can support. After this, the

IRP Manager communicates with the NBI Version Mediator 21 in the same (or similar) way as if it were any "real" IRP Agent, to explicitly request and determine what it can support that is not already supported by other "real" IRP Agents. For example, on the first request the IRP Agent may respond to say it supports R99 and R5 (e.g. specific releases of standards), but none respond that they support R4. On the second request the IRP Manager requests the NBI Version Mediator 21 as to what it can support. When the NBI Version Mediator responds R4, this is registered by the IRP Manager.

The NBI Version Mediator 21 then compares these requests with what the IRP Agents have indicated they could support, and against its available repertoire of conversions between NBI versions, to see if it can match and support mediation. The NBI Version Mediator 21 may also more explicitly try to rediscover further scope if this was not initially found on the first broadcast for discovery or fully confirmed to the level of detailed required. Where matches are confirmed and the NBI Version Mediator 21 is capable of resolving forward or backward compatibility using its mediation repertoire, it will indicate this to the IRP Manager in the same or similar way an IRP Agent would in conventional operation. In overview, for the specific mediation identified as possible, the NBI Mediator will maintain sufficient information internally so that when the instance of the IRP Manager subsequently uses the NBI Mediator for the scope identified, the NBI Mediator can associate it with the appropriate mediation from its repertoire and the specific instance of IRP Agent it needs to mediate between.

FIG. 4 is schematic illustration of the NBI Version Mediator 21 in terms of functional modules thereof. The NBI Version Mediator 21 comprises an NBI bus interface 41, a controller 42, a Pseudo Agent 43, a Pseudo Manager 44, a rules engine 45, and a rules database 46. The controller 42 is functionally coupled to the Pseudo Agent 43, the Pseudo Manager 44, the rules engine 45 and the NBI bus interface 41. The NBI bus interface 41 is also functionally coupled to each of the Pseudo Agent 43 and the Pseudo Manager 44. The Pseudo Agent 43 and the Pseudo Manager 44 are also functionally coupled to each other. The Pseudo Manager 44 is also functionally coupled to the rules engine 45. The rules engine 45 is also coupled to the rules database 46. An IRP Manager input 51 and an IRP Manager output 52 for communication with IRP Managers are provided for the NBI bus interface 41. An IRP Agent input 53 and an IRP Agent output 54 for communication with IRP Agents are also provided for the NBI bus interface 41. An operator (or user) interface 47, in this example a personal computer, is functionally coupled to the NBI Version Mediator 21, in this example to the rules database 46.

The NBI bus interface 41 provides interface to, for example, Common Object Request Broker Architecture (CORBA) which allows integration of a wide variety of object systems i.e. in this case IRP Managers and IRP Agents in an NMC & NEM based management network. This will now be described in more detail with reference to FIG. 5. FIG. 5 is a schematic illustration representing a request 60 being sent by a client 61 to an object implementation 62. The client 61 is the entity that wishes to perform an operation on the object and the object implementation 62 is the code and data that actually implements the object i.e.

IRP Manager and IRP Agent respectively. An Object Response Broker (ORB) 63 is responsible for the mechanisms required to find the object implementation 62 for the request 60, to prepare the object implementation 62 to receive the request 60, and to communicate the data making up the request 60. The interface the client sees is completely independent of where the object is located, what programming language it is implemented in, or any other aspect which is not reflected in the object's interface.

The controller 42 is responsible for overall control of the various modules of the NBI Version Mediator 21, and controls scheduling, maintaining threads and directing internal and external messages to appropriate modules and instantiations. The controller 42 maintains a record of concurrent processing and earlier records of negotiated supported mediations between IRP Managers and IRP Agents instances, within the domains of MOs, Versions, Operations and Notifications.

The Pseudo Agent 43 implements behaviour that emulates the regular IRP Agent for firstly responding to the IRP Managers with versions and scope supported for mediation, and secondly responding to operations and sending notifications for the versions of the interface being mediated.

The Pseudo Manager 44 implements behaviour that emulates the regular IRP Manager for interacting with other IRP Agents in the network to firstly get versions and scope supported by other IRP Agents, and secondly send

operations and receiving notifications to/from IRP Agents versions being mediated.

The rules engine 45 is responsible for providing, to the Pseudo Manager 44 and the Pseudo Agent 43, translations between incoming event and outgoing translated event, for all operation and notifications supported and between all versions mediated.

The rules database 46 holds a database of a predefined and/or updateable set of rules for translations to be performed by the rules engine 45. The rules engine identifies the valid scope of operations, mediated versions and Managed Objects (MO) supported by the NBI Version Mediator 21.

The operator interface 47 is provided to allow the rules database 46 and the rules engine 45 to be updated. The operator interface can also allow rules to be activated and deactivated in real time.

Each of the functional modules described above, and indeed the NBI Version Mediator 21 as a whole, may be implemented by configuring or adapting any suitable apparatus, for example a computer or other processing apparatus, forming all or part of one or more of the management parts of a communications system or network, or by providing new apparatus such as a computer or other processing apparatus. In all these cases, the apparatus may be in the form of hardware, firmware, or software, or any combination of these. The apparatus may comprise one or more processors, for implementing instructions and using

data stored in a storage medium such as a computer memory, hard disk, floppy disk, ROM, PROM etc. The processor may be a computer, a network of computers, or one or more dedicated processors, either collocated or distributed geographically.

A further aspect useful for understanding the present invention will now be described with reference to FIG. 6. FIG. 6 is a schematic illustration of a managed object containment tree, with IRP Agents scope superimposed over them. In FIG. 6, black squares represent managed objects, labelled here for example MO-1 to MO-15. Managed objects are a software object well understood by the skilled person. Lines connecting two managed objects represent containment. In this example, MO-1 may for example represent a managed object for a national cellular communication network operator's network, for example Vodafone (RTM). MO-2 may for example represent a managed object for vendor A's managed elements. MO-5 may for example represent a managed object for an RNC. MO-6 may for example represent a managed object for a Node-B. MO-10 may for example represent a managed object for a cell. In this example, the scope of IRP Agent 26 encompasses MO-2, MO-5, MO-6, MO-9 and MO-10; the scope of IRP Agent 27 encompasses MO-3, MO-7, MO-11, MO-14, MO-12 and MO-15; and the scope of IRP Agent 28 encompasses MO-4, MO-8 and MO-13.

FIGs. 7, 8 and 9 are call sequence flowcharts showing process steps employed in an embodiment of the present invention. FIG. 7 shows the overall

process steps at a network level; FIGs. 8 and 9 show process steps performed internally by the NBI Version Mediator during the overall process of FIG. 7.

The process shown in FIG. 7 is in two main stages. The first is initialisation, i.e. an initial "Get Versions" stage; the second is operations, i.e. general operation and notifications. At start up the Get Version is first run before operations and notifications can be mediated. (FIG. 8 shows internal steps during the initialisation stage of FIG. 7; FIG. 9 shows internal steps during the operations stage of FIG. 7).

In the general process of finding compatibility between IRP Manager instances and IRP Agent instances to be described with reference to FIGs. 7 to 9, it will be assumed that an IRP Manager initiates the process by searching for IRP Agents that:

- can support its requirements within the scope versions it can support,
- can support the scope of MOs (as in FIG. 6 for example) it requires to manage
- can support the operations and notification it wishes to apply to them.

Referring firstly to FIG. 7, at step s20 the IRP Manager 23 sends a get request to the IRP Agent 26 requesting whether the IRP Agent 26 supports version x (V_x) of the NBI. At step s40, the IRP Agent 26 responds to the IRP Manager 23 confirming that it does support version x. Optionally, at the same time as step s20 or as separate steps the IRP Manager 23 may request the scope of which MOs the IRP Agent 26 can support. In this case the IRP Agent 26 also

responds to this request, e.g. according to the example scenario shown in FIG. 6 the IRP Agent 26 responds indicating it can support MOs 2, 5, 6, 9 and 10. (Steps s20 and s40 are as performed in conventional arrangements, and are included for comparison purposes.)

In this example the same process(es) is (are) repeated for IRP Agent 27. At step s60, the IRP Manager 23 sends a get request to the IRP Agent 27 requesting whether the IRP Agent 27 supports version x (V_x) of the NBI. In the case of the IRP Agent 27 it does not support version x, it instead supports version x-1. Hence, at step s80, the IRP Agent 27 responds to the IRP Manager 23 with a message informing the IRP Manager 23 that the IRP Agent 27 does not support version x. Optionally, the IRP Agent 27 may also respond with an indication of which alternate versions it does support.

After receiving the IRP Agent 27's response that it does not support version x (or, if the IRP Manager 23 had also requested the MO scope, then after receiving the IRP Agent 27's response that it does not support version x and/or the requested MO scope), at step s100, the IRP Manager 23 sends the same request to the NBI Version Mediator 21, to determine whether it can support version x , and whether it can cover the required scope of MOs, i.e. the MOs of the IRP Agent 27, i.e. MOs 7, 11, 12, 14 and 15 as shown in FIG. 6).

Then the NBI Version Mediator 21 processes the get request and determines that it can potentially facilitate the IRP Manager 23's version x request by mediating between version x and version x-1 (as will be described in

more detail below with reference to FIG. 8). Thus the NBI Version Mediator 21 sends get requests to available IRP Agents to determine which ones support version x-1. For conciseness, only three such requests are described here, i.e. at step s110 the NBI Version Mediator 21 sends a get request for version x-1 to the IRP Agent 28, at step s120 the NBI Version Mediator 21 sends a get request for version x-1 to the IRP Agent 26, and at step s130 the NBI Version Mediator 21 sends a get request for version x-1 to the IRP Agent 27. (Note, steps s110, s120 and s130, and equivalent transmits to other IRP Agents, may be sent in the form of a broadcast transmission.)

At step s150, the IRP Agent 28 responds to the NBI Version Mediator 21 that it does not support version x-1; likewise at step s160, the IRP Agent 26 responds to the NBI Version Mediator 21 that it does not support version x-1. Hence these responses from these IRP Agents are not processed further by the NBI Version Mediator.

However, at step s180, the IRP Agent 27 responds to the NBI Version Mediator 21 that it does support version x-1, and for the context of the requested scope of MOs.

Thus the NBI Version Mediator 21 is aware that it will be able to facilitate the IRP Manager 23's version x request by mediating between version x and version x-1. Thus, at step s200, the NBI Version Mediator 21 responds to the IRP Manager 23 that it can support version x (and may further specify details of the

scope supported). Note it does not need to mention that the support will involve mediation through version x-1.

Above described steps s20 to s200 represent the initialisation stage of the overall process. On successful completion of this, the overall process moves to the operations stage, as follows.

At step s220, the IRP Manager 23 sends a message invoking an operation to the IRP Agent 26 under their shared version x and for an MO within the scope of the IRP Agent 26 (i.e. MO 2, 5, 6, 9 or 10 as shown in FIG. 6). The IRP Agent 26 straightforwardly performs the operation and, at step s240, returns the appropriate response. (Steps s220 and s240 are as performed in conventional arrangements, and are included for comparison purposes.)

We now consider the process when the IRP manager 23 wishes to invoke an operation under version x within the scope of the IRP Agent 27. As the outcome of the above described initialisation stage, the NBI Version Mediator 21 is viewed by the IRP Manager 23 as the entry point for such an operation. Therefore, at step s260, the IRP Manager 23 sends a message invoking the required operation to the NBI Version Mediator 21.

This is processed by the NBI Version Mediator 21 (as will be described in more detail below with reference to FIG. 9) to convert the received version x operation request into a version x-1 operation request and, at step s280, the NBI

Version Mediator 21 sends the corresponding version x-1 operation request message invoking the operation to the IRP Agent 27.

The IRP Agent 27 performs the operation, and, at step s300, returns the appropriate response (under version x-1) to the NBI Version Mediator 21.

The NBI Version Mediator processes the response (as will be described in more detail below with reference to FIG. 9) to convert (or translate) the version x-1 response to a version x response, and then, at step s320, sends the converted (or translated) response to the IRP Manager 23. Following an initial synchronous response there may follow additional subsequent associated asynchronous responses sent by the IRP Agent in the form of notifications. The NBI Version Mediator processes such notifications in a similar way i.e. steps s300 and s320 are repeated. Since notifications are associated with IRP Agent detecting events and the notification being sent to all IRP Managers that subscribed to a type and scope of notification the mediation will done in the context of each IRP Manager's original subscription operation.

Certain steps performed within the NBI Version Mediator 21 during the initialisation stage described above with respect to FIG. 7 will now be described with reference to FIG. 8.

FIG. 8 shows the above described step s100 of the NBI Version Mediator 21 receiving, from the IRP Manager 23, the get request under version x. More particularly, this is received by the NBI Bus Interface 41 module of the NBI

Version Mediator 21. A context and thread is then established and the Pseudo Agent 43 opened, so that from the perspective of the IRP Manager 23, the NBI Version Mediator 21 appears as a normal IRP Agent. In particular, at step s101, the get request is forwarded from the NBI Bus Interface 41 to the controller 42, and, at step s102, the get request is further forwarded from the controller 42 to the Pseudo Agent 43 which is thereby activated (or further activated if it has already been operating for other situations).

The Pseudo Agent 43 initiates a process of establishing what mediation, for version x in the context of the requested scope, it may support, by invoking the Rules Engine 45 and the Rules Database 46. In particular, at step s103, the Pseudo Agent 43 forwards a request support under version x message, and associated details, to the Rules Engine 45.

The Rules Engine 45, interrogating the Rules Database 46 as required, determines that in the present case the NBI Version Mediator 21 can potentially support mediation between versions x and x-1 provided it can locate an IRP Agent in the network able to support version x-1 for the requested scope. The Rules Engine 45 then invokes the Pseudo Manager 44, i.e. at step s104, the Rules Engine 45 sends, to the Pseudo Manager 44, a request support for version x-1 message, to request some or all known IRP Agents in the network if they can support version x-1 for the required scope.

The Pseudo Manager 44 now emulates an IRP Manager. In particular, the Pseudo Manager 44 formulates a get request under version x-1 for the required

scope, and at step s105 forwards this get request to the controller 42. At step s106, the controller 42 forwards this version x-1 get request to the NBI Bus Interface 41.

The NBI Bus Interface 41 then sends this get request under version x-1 to relevant IRP Agents. In this particular example, this corresponds to steps s110, s120 and s130 described above with reference to FIG. 7, i.e. at step s110 the NBI Version Mediator 21 sends a get request for version x-1 to the IRP Agent 28, at step s120 the NBI Version Mediator 21 sends a get request for version x-1 to the IRP Agent 26, and at step s130 the NBI Version Mediator 21 sends a get request for version x-1 to the IRP Agent 27.

For consistency with FIG. 7, FIG. 8 shows step s150, where the NBI Bus Interface 41 receives, from the IRP Agent 28, the response that the IRP Agent 28 does not support version x-1, and step s160, where the NBI Bus Interface 41 receives, from the IRP Agent 26, the response that the IRP Agent 26 does not support version x-1. These IRP Agent responses are not processed further by the NBI Version Mediator 21.

In addition, at step s180, the NBI Bus Interface 41 receives, from the IRP Agent 27, the response that the IRP Agent 27 does support version x-1 for the given scope. At step s181, this response is forwarded to the controller 42, and further at step s182 this response is forwarded to the Pseudo Manager 44.

The Pseudo Manager 44 responds to the Rules Engine 45 that there is an IRP Agent that can support version x-1 for the given scope, i.e. at step s183 the

Pseudo Manager 44 effectively forwards the response that IRP Agent supports version x-1 to the Rules Engine 45.

The Rules Engine 45 processes this information, in part by interrogating the Rules Database 46. Then the Rules Engine 45 updates the controller 42 with the current valid supported mediation between the IRP Manager 23 and the IRP Agent 27 for future context and scheduling of communication of these specific entities i.e. at step s184 the Rules Engine 45 sends updated support mediation information to the controller s42, indicating that mediation is supported between IRP Manager 23 and IRP Agent 27for the required scope.

At step s185, the Rules Engine 45 furthermore sends a response to the Pseudo Agent 43 indicating that mediation for version x is supported. The information may also include specifics of the actual scope supported, derived from the response received from the IRP Agent 27 and the Rules Database e.g. the MOs supported by the IRP Agent 27.

At step s186, the Pseudo Agent 43 effectively forwards this support version x message to the controller 42. At step s187 the controller further forwards this message to the NBI Bus Interface 41.

Then the NBI Bus Interface 41 performs the earlier described step s200 of the NBI Version Mediator 21 responding to the IRP Manager 23 that it can support version x (and may further specify details of the scope supported).

Certain steps performed within the NBI Version Mediator 21 during the operations stage described above with respect to FIG. 7 will now be described with reference to FIG. 9.

FIG. 9 shows the above described step s260 of the NBI Version Mediator 21 receiving, from the IRP Manager 23, the message invoking the required operation under version x. More particularly, this is received by the NBI Bus Interface 41 module of the NBI Version Mediator 21.

At step s261, this operation request is forwarded to the controller 42. At step s262, the controller 42 forwards the operation request to the Pseudo Agent 43.

The Pseudo Agent 43 will now emulate an IRP Agent from the perspective of the IRP Manager 23. The Pseudo Agent 43 does this as follows. At step s263, the Pseudo Agent 43 requests the Rules Engine 45 to convert the version x based operation and MOs to version x-1, apply and return the response.

Based on the information supplied by the IRP Manager 23, the Rules Database, and information held by the controller after initialisation, the Rules Engine translates the operation request and MO from version x to version x-1 (as required for mediation between version x and version x-1).

Then, at step s264, the Rules Engine 45 sends a request to the Pseudo Manager 44 effectively requesting it to request the IRP Agent 27 to process the converted version X-1 based operation.

The Pseudo Manager formulates the operation request as a standard version x-1 operation, and, at step s265, forwards this version x-1 operation to the controller 42. At step s266 the controller forwards the operation to the NBI Bus Interface. At step s280, as described above with reference to FIG. 7, the NBI Bus Interface 41 sends the operation to the IRP Agent 27.

The IRP Agent 27 receives the x-1 operation, and applies the operation to its version x-1 MOs. At step s300, as described above with reference to FIG. 7, the IRP Agent 27 returns a version x-1 response for the operation to the NBI Bus Interface 41 of the NBI Version Mediator 21.

At step s301, the NBI Bus Interface 41 forwards the response to the controller 42. At step s302, the controller 42 forwards the response to the Pseudo Manager 44.

At step s303, the Pseudo Manager 44 and the Rules Engine 45 interact, and interrogate the Rules Database as 46 required, to convert (or translate) the x-1 version of response to an x version response.

At step s304, the Pseudo Manager 44 forwards the x version response to the Pseudo Agent 43. The Pseudo Agent 43 can now respond in the manner of a

standard IRP Agent to the operation request received by virtue of steps s260, s261 and s262. More particularly, at step s305, the Pseudo Agent 43 forwards the version x response to the controller 42. At step s306, the controller 42 forwards the version x response to the NBI Bus Interface 41. At step s320, as described above with reference to FIG. 7, the NBI Bus Interface 41 sends the version x response to the IRP Manager 23. This concludes this particular process of the operation for the MOs.

Internally, notifications are processed in a similar way to the synchronous IRP Agent response handling shown in FIG. 9 i.e. steps s300 through s320 inclusive in the context of the IRP Manager original subscription operation.

It will be appreciated that the process steps described above, and the order in which they are performed, are by way of example only. In practice the process will vary according to the arrangement of IRP Managers, IRP Agents, networks, scopes required to be processed, and so on. Likewise, the process may vary according to ways in which the NBI Version Mediator, or corresponding apparatus, is implemented. For example, process steps will vary according to which functional modules form the NBI Version Mediator, and according to which way such modules interact.

The above embodiments provide the potential for the following advantages, amongst others, to be obtained:

- Avoidance or at least reduction the need to upgrade all network managers and network elements to a common version of the NBI.

- Support for legacy entities in an evolving network without the need to upgrade them.
- The process and arrangement is transparent to extant IRP Managers and IRP Agents.
- Prior art in this area means in general Reduces or removes the need for IRP Managers and IRP Agents to be able to support at least 1 common version of the interface without communication failing due to incompatible operation signatures at the NBI implementation level.
- Common version mediation may be applied to operations, notifications and MOs.
- May be applied to different vendors and/or ISVs.
- May be employed as a temporary measure while differences of versions in a management layer of a network are updated or otherwise resolved.

CLAIMS

1. A method of communicating between a telecommunications network management centre, NMC (10), and a telecommunications network element manager, NEM (4), over an interface (15) defined by a standard, the NMC (10) using one version of the standard, hereinafter called the first version of the standard, and the NEM (4) using a different version of the standard, hereinafter called the second version of the standard; the method comprising:

one of the NMC (10) and the NEM (4) sending a request under the first version of the standard to a mediator (21);

the mediator (21) converting the request under the first version of the standard to a corresponding request under the second version of the standard;

the mediator (21) sending the corresponding request under the second version of the standard to the other of the NMC (10) and the NEM (4);

the other of the NMC (10) and the NEM (4) sending a response under the second version of the standard to the mediator (21);

the mediator (21) converting the response under the second version of the standard to a corresponding response under the first version of the standard; and

the mediator (21) sending the corresponding response under the first version of the standard to the one of the NMC (10) and the NEM (4).

2. A method of mediating communication between a telecommunications network management centre, NMC (10), and a telecommunications network element manager, NEM (4), over an interface (15) defined by a standard, the

NMC (10) using one version of the standard, and the NEM (4) using a different version of the standard; the method comprising:

receiving a request under a first version of the standard from one of the NMC (10) and the NEM (4);

converting the request under the first version of the standard to a corresponding request under a second version of the standard;

sending the corresponding request under the second version of the standard to the other of the NMC (10) and the NEM (4);

receiving a response under the second version of the standard from the other of the NMC (10) and the NEM (4);

converting the response under the second version of the standard to a corresponding response under the first version of the standard; and

sending the corresponding response under the first version of the standard to the one of the NMC (10) and the NEM (4).

3. A method according to claim 1, further comprising the mediator (21) determining a suitable NMC (10) or NEM (4) under the second version of the standard from among a plurality of NMC's or a plurality of NEM's.

4. A method according to claim 2, further comprising determining a suitable NMC (10) or NEM (4) under the second version of the standard from among a plurality of NMC's or a plurality of NEM's.

5. A method according to any of claims 1 to 4, wherein the request under the first version of the standard is from an Integration Reference Point manager of

the one of the NMC (10) and the NEM (4), and the response under the second version of the standard is from an Integration Reference Point agent of the other of the NMC (10) and the NEM (4).

6. A method according to claim 5, wherein the mediator (21) emulates an Integration Reference Point manager and an Integration Reference Point agent.

7. A method according to any of claims 1 to 6, wherein the request under the first version of the standard is one of the following group:

(i) a get request;

(ii) a request to perform an operation; and

(iii) a notification.

8. A method according to any of claims 1 to 7, wherein the standard is a 3rd Generation Partnership Project Universal Mobile Telecommunications System (UMTS) Management standard, and the interface is the north bound interface, NBI.

9. A storage medium storing processor-implementable instructions for controlling a processor to carry out the method of any of claims 1 to 8.

10. Apparatus for mediating communication between a telecommunications network management centre, NMC (10), and a telecommunications network element manager, NEM (4), over an interface defined by a standard, the NMC (10) using one version of the standard, and the NEM (4) using a different version of the standard; the apparatus comprising:

means for receiving a request under a first version of the standard from one of the NMC (10) and the NEM (4);

means for converting the request under the first version of the standard to a corresponding request under a second version of the standard;

means for sending the corresponding request under the second version of the standard to the other of the NMC (10) and the NEM (4);

means for receiving a response under the second version of the standard from the other of the NMC (10) and the NEM (4);

means for converting the response under the second version of the standard to a corresponding response under the first version of the standard; and

means for sending the corresponding response under the first version of the standard to the one of the NMC (10) and the NEM (4).

11. Apparatus according to claim 10, further comprising means for determining a suitable NMC (10) or NEM (4) under the second version of the standard from among a plurality of NMC's or a plurality of NEM's.

12. Apparatus according to claim 10 or 11, wherein the request under the first version of the standard is from an Integration Reference Point manager of the one of the NMC (10) and the NEM (4), and the response under the second version of the standard is from an Integration Reference Point agent of the other of the NMC (10) and the NEM (4).

13. Apparatus according to claim 12, adapted to emulate an Integration Reference Point manager and an Integration Reference Point agent.

14. Apparatus according to any of claims 10 to 13, wherein the request under the first version of the standard is one of the following group:

(i) a get request;

(ii) a request to perform an operation; and

(iii) a notification.

15. Apparatus according to any of claims 10 to 14, wherein the standard is a 3rd Generation Partnership Project Universal Mobile Telecommunications System (UMTS) Management standard, and the interface is the north bound interface, NBI.

16. A method of communicating between a network management centre and a network element manager substantially as hereinbefore described with reference to the accompanying drawings.

17. Apparatus for mediating communication between a network management centre and a network element manager substantially as hereinbefore described with reference to the accompanying drawings.

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Claims searched:	1 to 17
Examiner:	Daniel Voisey
Date of search:	14 May 2003

Patents Act 1977 : Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance	
X	1, 2, 8 to 10 and 15	EP 1050994 A2	(ALCATEL) see particularly paragraphs [0001] and [0003] and figure 1.
X	1, 2, 8 to 10 and 15	GB 2301754 A	(DSC) see particularly page 1 line 5 to page 2 line 1.

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category	P	Document published on or after the declared priority date but before the filing date of this invention
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC[V]:

H4K, H4L

Worldwide search of patent documents classified in the following areas of the IPC[7]:

H04L, H04Q

The following online and other databases have been used in the preparation of this search report:

WPI, EPODOC, JAPIO